

DESIGN AND IMPLEMENTATION OF VIDEO CONFERENCING CLOUD- BASED NETWORK USING VOIP FOR REMOTE HEALTH MONITORING IN TELEMEDICINE SYSTEM

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Abstract— Telemedicine is one of the promising applications that are expected to be widely used in the health and medical fields. Video-over-IP is a suggested solution for supporting Telemedicine at rural health clinics in developing countries. In this paper, we describe the design and implementation of a prototypical telemedicine video conferencing system that allows real-time remote monitoring of medical events using the Internet and provides the involved doctors and/or consultants with the ability to discuss and confer using both audio and video to help provide the best medical care at low cost. We present the tools used to design and build the system, the challenges encountered and the solutions adopted.

Keywords— Telemedicine, Videoconferencing, Video-over-IP, cloud computing, broadcasting, Health Monitoring synchronization

I. INTRODUCTION

The evolution and emergence of different technologies into the Internet has enhanced and facilitated the existence of new applications and services, such as telemedicine, video conferencing, Video over IP (VoIP), Video on Demand (VOD), cloud computing, etc. Telemedicine is one of those applications that are expected to be widely used in the next few years [1]. One motivation for developing a telemedicine system is cost effectiveness for sharing resources, and exchanging information between different people in different places. It not only reduces cost, but also removes the necessity of travel for both patients and doctors. This is extremely useful especially in some regions like rural areas, which might lack the existence of specialist medical personnel.

Telemedicine has many implementation challenges, such as: infrastructure planning and development, system design and architecture, security and confidentiality, licensing and authenticity, Internet reliability and speed of communication [2], [3]. Researchers have suggested several models for telemedicine systems.

This paper deals with system architecture and design aspects, with an emphasis on practical implementation issues. The rest of the paper is organized as follows: Section II presents the previous contributions in telemedicine video conferencing systems, Section III describes the system architecture and the tools used in the design. Section IV describes some practical issues must be considered during implementation, and provides an efficient way for solving these problems. Finally, section V concludes the paper and suggests future work.

II. PREVIOUS CONTRIBUTIONS IN TELEMEDICINE VIDEO CONFERENCING SYSTEMS

A. *Quality Attributes in Telemedicine Video Conferencing*

In [4], the authors suggested a quality attributes model for telemedicine video conferencing system. Their model was developed from extensive literature review, direct observations of telemedicine system encounters and interviews with telemedicine experts. The model consists of four main quality attributes groups: technical issues, usability, human element and physical environment. Their model describes the attributes and parameters that should be taken into consideration to build a telemedicine system. However, it contained few technical details about practical and implementation issues.

B. Performance Evaluation of Telemedicine System

In [5], the authors designed a real-time telemedicine system that enables medical examination and diagnosis made by several specialists simultaneously. Their major concern was to study network performance in terms of bandwidth, delay, packet loss, and jitter and their impact on the system.

C. A multimedia telemedicine system

In [6], the authors designed a Multimedia Telemedicine System (MTS) that enables doctors to communicate with patients in different methods using real-time data including audio, video and Instant Messages (IM), and non-real-time data, such as radiological signals, bio-signals, and bio-data.

D. Advanced Video Conferencing Technology

In [7] Nefsis takes full advantage of state-of-the-art cloud computing and dynamic scalable video to accelerate multipoint HD video conferencing and live sharing. In addition, Nefsis multi-core concurrency brings far more processors to bear than traditional single-CPU codec boxes, Flash and JavaScript environments.

E. Multi-Network Video And Voice Conferencing On A Single Platform

The technical white paper in [8] provides an overview of the issues, capabilities and benefits to be expected from a single platform solution for video and voice multipoint and gateway conferencing. How POLYCOM meets these challenges and how to configure the POLYCOM Unified Conferencing Bridge to meet your requirements are also addressed.

The given 5 examples for the contributions in video conferencing telemedicine system and there are more details about the system components discretion or review in [9-15]

III. PROPOSED SYSTEM ARCHITECTURE

A. Proposed Architecture.

The proposed telemedicine system has two major functionalities; providing the user with a remote monitoring facility for a live event (a medical operation in our case), and allowing different users from different physical locations to conduct a video conference; discussing and exchanging information regarding the ongoing live event. Fig.1 shows the architecture of the proposed video conferencing system.

The remote monitoring functionality is provided by using different IP cameras located in different positions in operation room, which broadcast the medical operation event to the client involved in the video conference. These cameras have a built-in access server which receives the clients' requests and broadcasts the video streams to the requesting clients. Each camera is located in a different position to get different views of the same scene. The user - after getting permission or assigning one of the users as administrator- has the option of zooming any of these cameras. The choice of the IP cameras was based on four major factors: The real-time response of the cameras, the availability of the Software Development Kit (SDK), the support of different protocols such as Real Time Streaming Protocol (RTSP) for media announcement, Real-time Transport Protocol (RTP) for media transmission, and Real-time Transport Control Protocol (RTCP) for RTP control, and the maximum resolution of the cameras.

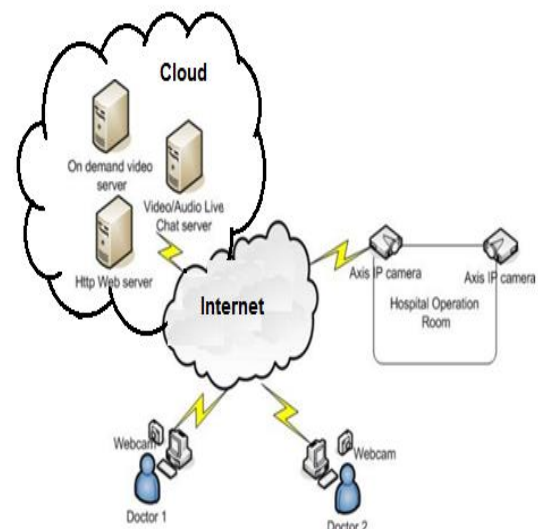


Figure 3.1: The video conferencing system architecture

The video conferencing functionality is provided through a web-based interface that enables the

users to view the IP camera broadcast and to conduct a video conference. There are different methods to build the video conferencing system; the most efficient way is to build the system using a video conferencing software development kit, which provides the user with several multimedia components; such as the audio and the video encoder/decoder, the web page plug-ins, and the media player. These components can be easily integrated into the user application. Lead tools [16], PY Software tools, and Viscomsoft tools [17-18] are some examples of these tools.

The structure of the video conferencing system is based on a client and cloud-based server architecture with open source cloud platform as open stack. On the client side, the client accesses the web server to get the main web page, through which he/she get connected to the video conferencing server, and joins the conference as shown in Fig. 2. To achieve this functionality, three ActiveX components are embedded into the client's web page; one for encoding the audio signal generated from the microphone attached to the client's computer and broadcasts it to the conference server. The second ActiveX component is used for encoding and broadcasting the video signal generated from the webcam attached to the client's computer. While the third ActiveX component is the media player that receives and plays-out the video and audio streams of the other clients who joined the conference. As shown in Fig. 2, in the upper corners, the IP camera's ActiveX players display the streamed video from the operation room. The user has the option of zooming into these cameras by clicking the zoom-in icon. As a result, a larger view of the camera is displayed in the middle of the web page. In the middle right and left sides, the video streams generated by the participants web cams are displayed, two in this case; Doctor1, and Doctor 2, who have joined the conference.



Figure 3.2: Lab for Telemedicine client web based interface

On the server side, the conference server receives the audio/video streams from the clients who joined the conference, and broadcasts these streams to the connected clients. Also, we have setup an on demand video server using Windows Media Server software that comes with Windows 2003 server operating system [11]. The purpose of this server is to record the ongoing video conference sessions, and record the live IP camera's broadcast for archiving purposes and for later viewing.

IV. TELEMEDICINE SYSTEM IMPLEMENTATION USING VOIP: DISCRIPTION AND CONSIDERATIONS

A. Voice Quality Requirements

The quality of a call can be measured using one of several call quality metric calculations. The most commonly used system is the Mean Opinion Score (MOS). The MOS score of a call is between 1 (for unusable) and 5 (for excellent). VOIP calls that are working properly fall between 3.5 and 4.2. 4.0 is defined as toll quality. Other systems for quality measurement are R-factor, PSQM, PESQ, and PAMS. These other systems produce scores for a call that can be mapped to MOS for comparison. MOS score, in table.1, is an indication of what users would think about the call. It was developed using surveys of users of different technologies, but today it is calculated through the use of engineering formula.

Table 1: MOS Score

MOS	Listening Quality	Listening Effort
5	Excellent	Complete Relaxation
4	Good	Attention Necessary
3	Fair	Moderate Effort
2	Poor	Considerable Effort
1	Bad	No Meaning Understood

A. Ain Medical VoIP Implementation

This section will represent the video conference using VoIP that we applied in our portal (www.ainmedical.com).

For patient to use these services:

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